Towards integrated municipal waste management: technical guide for technology identification and screening for integrated waste management planning

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ABSTRACT

Although we have seen strong growth in both the interest and implementation of alternative waste management in South Africa, many municipalities are still struggling in the development and implementation of alternative waste management - including securing adequate funding. The development of 1st and 2nd generation Integrated Waste Management Plans over the last 10 years indicates progress in the way municipalities have approached waste management, but there has been until now limited detail on implementation addressed in these plans - including infrastructure, budgetary and human capital capacity needs. This paper outlines the development of a simple technical guide aimed at assisting municipalities in determining technologies appropriate for their local contexts, as well as providing a first level costing estimate and additional rules of thumb to be taken into account when considering specific technologies.

Keywords: Alternative Waste Management, Municipal Decision Support, Technology Selection, Integrated Waste Management Plan

1. INTRODUCTION

Waste management in South Africa has received an increased focus over the last few years, and we have observed a slow but gradual shift from primarily landfill-disposal waste management to a system that is working on retaining the resource value of waste. In the 2016 Department of Environmental Affairs (DEA) presentation of the budget speech to Parliament by the Minister of Environmental Affairs, there was a very strong emphasis placed on promotion of sustainable waste management practices. In particular, the presentation highlighting a number of initiatives that government has put in place to support the objectives of the National Waste Management Strategy (NWMS) (Parliament of South Africa, 2016). In terms of the NWMS (Department of Environmental Affairs, 2012) government aimed to achieve the following (*inter alia*) targets by 2016:

- 25% diversion of recyclables from landfill, and the
- creation of 69,000 jobs as well as 2,600 SMMEs.

However, the Minister (in her speech) highlighted that to meet these and other objectives, a number of issues still need to be addressed at municipal level. These include support, capacity and awareness around waste management.

The Western Cape has 167 waste disposal facilities, but more importantly, over a hundred licensed waste management facilities including drop off facilities, transfer stations, material recovery facilities, composting and waste to energy facilities (Arendse, 2016). Although the Western Cape is achieving a diversion rate higher than the national average, 90% of waste generated in South Africa is still ending up in landfills (Department of Science and Technology, 2014). This illustrates a large disconnect between the targets being set and the actual waste minimisation activities (undertaken at the municipal level).

All the 30 municipalities (within the Western Cape) – with assistance from the Department of Environmental Affairs and Development Planning (DEA&DP) – have developed their 1st and 2nd generation Integrated Waste Management Plans (IWMPs), with the call for the 3rd generation IWMPs expected to go out in the 2017/2018 financial year. Deficiencies highlighted in the IWMPs, across both 1st and 2nd IWMPs, include the need to address compliance gaps, and the lack of waste information. Thus, it is expected that the 3rd generation IWMPs will have a much stronger focus on implementation plans to address gaps and needs identified, including the implementation of alternative waste management technologies.

1.1 Background to the need of a decision support tool for municipalities

In our previous paper (Sango, et al., 2014), the waste management challenges facing South African municipalities were discussed. These included increasing volumes of waste generated, and increasing costs associated with a progressively more stringent regulatory landscape. These changes have in turn led to capacity challenges - both in terms of financial and human capital - in adopting the goals of the National Waste Management Strategy (Department of Environmental Affairs, 2012) to shift from unsustainable disposal practices to more environmentally friendly alternative waste management technologies.

Based on the waste management challenges, there was an influx of offers from a large number of parties offering a range of technologies to assist the municipalities to improve their waste management. In order to assist the municipalities in determining appropriate technologies for their contexts and ensuring that they take into account the full life cycle impact of these offerings, GreenCape developed an integrated waste management decision support tool (IWM-DST) aimed at assisting municipalities in the evaluation of the implementation of these technologies based on a full systems approach. This was aimed at ultimately ensuring that the municipalities would account for the full (life cycle) cost of implementation, taking into account both upstream and downstream impacts and considerations.

1.1.1 Tailoring of the IWM-DST

The decision support tool was tailored to incorporate decision making criteria relevant to South African municipal decision making, including:

- environmental criteria from the development and tailoring of a Danish Integrated Waste Management Tool (EASETECH) to the South African context
- financial criteria (and any additional criteria such as job creation potential) from the development of an excel-based model

The tailoring, development and testing of the decision support tool was done via a municipality case study. Stellenbosch Municipality was selected as the first case study due to their critical need to divert waste from landfill – with less than 4 years landfill airspace in 2014, and no viable alternatives for new landfill sites within the municipal boundary. In addition, the municipality was one of the first municipalities to develop a good grasp on their waste information – from actual recording of weighbridge information, to waste characterisation – as well as a very proactive solid waste manager.

1.1.2 IWM-DST as part of a municipal decision support framework

Through the process of developing the IWM-DST, the role of the IWM-DST was envisaged to complement the municipal (waste management) decision support framework as illustrated in Figure 1 below. Importantly, the success would be strongly dependent on a municipality having a solid grasp of their current waste generation and management information in order to establish a baseline for comparison.

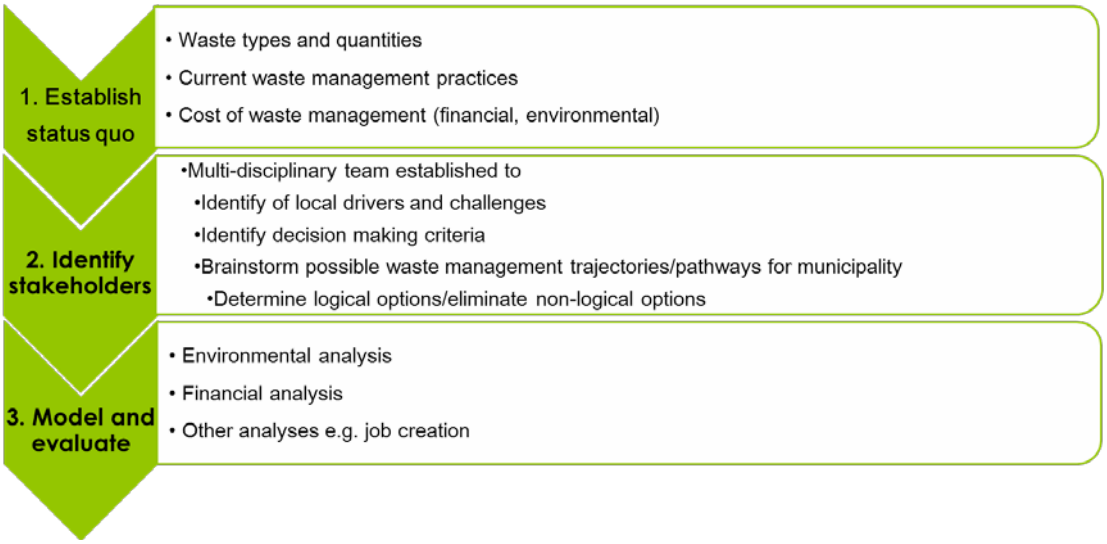

Figure 1: Municipal Decision Support Framework – technical aspects

Following on from this stage, the IWM-DST outputs can then be used to inform municipal planning processes, starting from the sectoral Integrated Waste Management Plan (IWMP), to the Integrated Development Plan (IDP) – which strongly influences the budgetary allocations within the municipality.

Figure 2: Municipal Decision Support Framework – integration into municipal decision processes

1.1.3 Insights from development and tailoring of IWM-DST and background to the need for a technical guide

The results from the case study were used to inform the municipality's planning processes, including:

- Feeding into a draft document that will be updated into the municipality's 3rd generation IWMP when the Provincial Government calls for these
- Informing a waste-to-energy feasibility study as well as the Municipal Systems Act (No 32 of 2000) section 78.3 study

In addition, the output provided from the use of the IWM-DST was a quantitative analysis of the cost and impacts – including benefits – of different waste management futures, and this provided a real platform for engagement with decision makers. One of the key outcomes for the case study was therefore the real benefits of looking at a regional waste management approach as this provided the least costly option. In particular, it also provided a quantifiable, fact based analysis of the severity of the size of the problems facing the municipality as well as the potential impact of inaction.

However, following engagement with smaller municipalities as well as the DEA&DP, and through presentation at the provincial waste management officers' forums; the need for a much simpler, first-pass tool was highlighted. The municipal waste management officers requested that a basic guide be developed, that could assess/investigate technologies that a municipality could consider based on its waste generation profile to inform the preliminary stages of municipal waste management planning. The specific purpose of this technical guide was therefore to:

- be a first level screen for technology selection
- determine what technology options each municipality should be investigating in more detail in their context;
- provide a sufficient evidence base for inclusion of specific technologies into high-level municipal planning documents;
- give general rules of thumb for other considerations, and direct the user to more detailed information.

1.2 Objective

The objective of this paper is therefore to present the process followed in the development of a technical guide aimed at assisting municipalities in determining what waste management technologies may be relevant for their particular context, as well as a high level (first pass) cost estimate of the implementation of each technology. The outcomes from the use of the technical guide would then inform more detailed studies in the municipal waste management planning cycle as outlined in Figure 3. In summary, the overarching aim of the technical guide is to assist municipalities in developing better IWMPs by providing guidelines (rules of thumb) for selecting (i.e. identifying and screening) technology options for the range of waste streams to be managed.

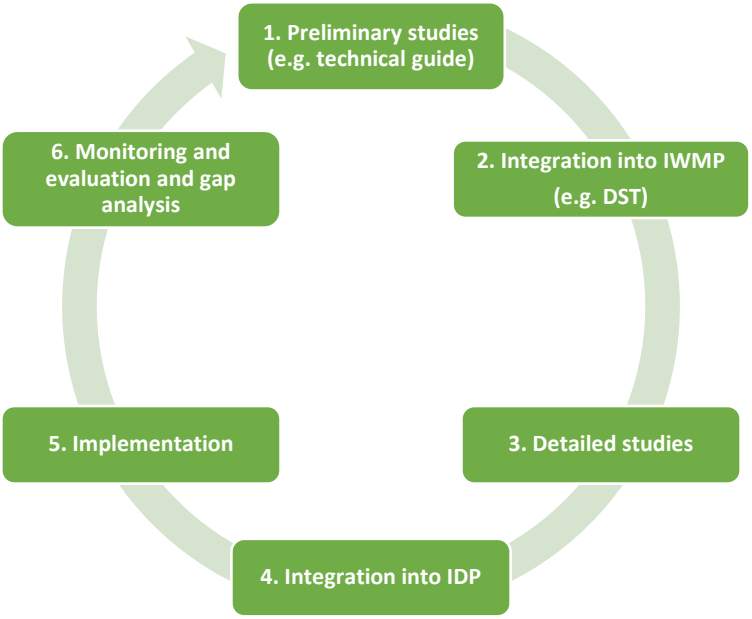

Figure 3: Example of municipal project cycle for waste management

2. APPROACH TO TECHNICAL GUIDE DEVELOPMENT

The guide was broken down into three main sections:

- User inputs – basic information that the municipality needs to enter based on their own information, or other decision support tools available
- Targets – critical to formulating any implementation plan, this aims at getting municipalities to set specific targets for future waste management
- Outputs – this summarises the potential waste management technologies a municipality may consider, and gives an indication of the cost of treatment per technology.

2.1 User input requirements

The user input requires the municipality to enter basic information that would allow determination of both current and future waste generation quantities. Where possible, actual waste generation quantities would be entered.

2.1.1 Waste generation information

Lack of waste information is a challenge for integrated waste management planning currently, with a total of 7 (waste facility) weighbridges in 2014. To address this, the DEA&DP has worked closely with municipalities in addressing this gap – both in terms of estimating waste generation rates, as well as waste characterisation.

Amount of waste generated is perhaps the most critical aspect of the technical guide, as errors in this aspect will render impractical solutions. Ideally, the municipalities should enter its waste information based on any of the following:

- Weighbridge or weigh pad information
- Estimates based on the waste calculator (developed by the DEA&DP)

In the absence of these, the municipality can enter its population (and growth rate in all cases), and from this information, an estimate of waste generation per capita is then used to estimate the overall waste generation rate of the municipality.

2.1.2 Waste characterization

Because waste management technologies are feed specific, accurate waste characterisation information is also essential in order to ensure that the proper technologies are selected for the specific waste types identified per municipality. The DEA&DP conducted waste characterisation studies across all Western Cape municipalities in 2007, and has gone out to provide additional training to all the local municipalities over the last two years.

2.1.3 Current waste management handling and cost

A benchmark for current waste management handling and cost is determined by entering information on:

- Levels of aggregation of different streams (i.e. availability of separation at source, drop off information)
- Annual cost of collection, transport and processing or disposal of the different waste streams (aggregated versus disaggregated, recycling, landfill etc.)

In the absence of local municipal information, estimates of these costs (per tonne) are available based on available case study information, and these estimates (along with other assumptions) will be modified in future work to reflect additional experience/accuracy based on collection of new information.

2.2 Projected waste management targets

Waste handling targets (primarily availability of and participation rates in separation at source programmes) over defaults of 5, 10, 15 and 20 years are entered, as this impacts the availability and quality of the different waste streams, and therefore the potential treatments.

Waste generation is by default estimated based on population growth rate. However, municipalities are advised to take cognisance of additional factors such as projected changes in income levels as these have also been shown to impact waste generation rates.

2.3 Viability of treatment options

Based on the waste information entered and the waste targets, the range of possible treatment options available per stream are determined. The outputs as illustrated in Figure 4 are:

- Verification of availability of material
- Typical cost of treatment per tonne (cost of collection, transport etc)
- Actual cost of treatment for waste stream, subject to the following
    - sized at 150% the size of the waste stream to account for seasonality and future growth;
    - six tenths rule for cost estimation (Gerard, 2007)
- Actual levelised cost per tonne for each waste treatment

Figure 4: Screenshot of technology options

3. CONCLUSION

The aim of the technical guide is to ensure that municipalities start preparing for essential infrastructure needs in waste management at an early stage. With mandated municipal procedures, the IWMP is meant to provide a detailed plan on how a municipality intends to meet its goals and objectives (aligned with provincial and national goals). The technical guide was therefore developed in order to give municipalities an idea of the potential technologies they may consider for waste management, as well as to give an estimate of the potential cost as well as other considerations of implementing the different technologies. This would in turn enable budgetary consideration for waste management technologies in integrated development processes, ultimately allowing for planning and unlocking of funding.

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